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STORAGE

REPORT

OF

THE DIRECTOR

OF THE

ROYAL OBSERVATORY, HONGKONG,

FOR THE YEAR

1915.

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REPORT OF THE DIRECTOR OF THE ROYAL OBSERVATORY, HONGKONG, FOR THE YEAR 1915.

I.—GROUNDS AND BUILDINGS.

The grounds were kept in order by the Botanical and Forestry Department with the assistance of the two Observatory coolies.

The growth of the blue grass (ophiopogon) planted in the spring of 1914, has been very slow. It has not spread sufficiently to prevent erosion.

The concrete on the paths in front of the main building was renewed in the month of February.

The other paths were considerably damaged by heavy rain in the summer months.

II.—METEOROLOGICAL INSTRUMENTS.

Kew Barograph.—In the month of April the accumulator battery was made to operate the relay of the electric time-scaling apparatus, as it was found that the battery of dry cells formerly in use was unsuitable for the work.

Beckley Anemograph.—Since the introduction of the accumulator battery for operating the time-scaling apparatus in April, this instrument has worked continuously well. It is cleaned and oiled once a month.

Dines-Baxendell Anemograph.—This instrument has also worked well since the introduction of the accumulator battery for operating the time-scaling apparatus. The spindle of the float is cleaned once a week and the head oiled once a month.

The monthly results of comparisons with the records of the Beckley Anemograph since the installation of the Dines instrument, in April 1910, are given below :—

Month.	Factor (Dines $\div \frac{\text{Beckley}}{3}$).					
	1910.	1911.	1912.	1913.	1914.	1915.
January, ...	......	2·33	2·30	2·12	2·54	2·03
February, ...	......	2·34	2·32	2·30	2·40	2·06
March,................	......	2·30	2·35	2·25	2·33	2·04
April, ...	......	2·27	2·33	2·26	2·25	2·05
May, ...	2·23	2·25	2·34	2·22	2·13	2·23
June, ...	2·23	2·10	2·44	2·09	2·13	2·22
July, ...	2·14	2·21	2·57	2·28	2·26	2·05
August, ...	2·07	2·25	2·65	2·39	2·18	2·07
September, ...	2·18	2·31	2·49	2·81	2·22	2·19
October, ...	2·30	2.27	2·51	2·69	2·08	2·23
November, ...	2·28	2·27	2·47	2·71	2·08	2·08
December, ...	2·23	2·31	2·24.	2·54	2·07	2·07
Year, ...	2·25	2·29	2·41	2·39	2·22	2·11

Kew Thermograph.—This instrument, which was set up in the new thermometer shed in January 1914, was dismounted in the month of April. The clock stopped frequently, and on examination was found to be badly rusted. It is not designed for an open exposure. It is proposed to substitute a Richard hygrograph.

Thermometers.—All thermometers in use were compared with the Kew Standard in winter and summer.

The following table shows the results of comparisons between the Kew standard purchased in 1884 and a Griffin Standard of Jena Normal Glass purchased in 1914. When compared with the National Physical Laboratory Standard, in April 1914, this thermometer required a correction of 0°·09F, which has been duly applied :—

Date.	Kew Standard 647	Griffin 29996 (*corrected*).	K – G
	°	°	°
1914 July 2, ...	81·82	81·72	+0·10
1915 January 19, ...	60·00	59·86	+0·14
1915 September 29, ...	90·00	89·93	+0·07

The results indicate that the Kew Standard No. 647 reads 0°·10 too high ; a very small change in thirty years.

III.—METEOROLOGICAL OBSERVATIONS AT THE OBSERVATORY.

Continuous photographic records showing the variations of barometric pressure and temperature, dry and wet bulb*, were obtained with Kew pattern instruments, and automatic records of the direction and velocity of the wind with a Beckley and a Dines-Baxendell anemograph, modified as described in the Report of 1912. The amount of rain is recorded automatically by a Beckley and a Nakamura pluviograph, the amount of sunshine by a Campbell-Stokes universal sunshine recorder, and the relative humidity of the air by a small Richard hair hygrograph.

Eye observations of barometric pressure, temperature of the air and of evaporation were made at each hour of Hongkong Standard time. (Until the end of the year 1912 they were made at each hour of Hongkong Local time.) The character and direction of motion of the clouds were observed every three hours. Daily readings were taken of self-registering maximum and minimum thermometers.

Principal Features of the Weather in 1915.—The principal features of the weather in 1915 were the absence of typhoons till the autumn, high temperature, low wind velocity, and large variations of pressure above and below normal. The seasonal distribution of rainfall was somewhat abnormal, being moderately in defect in April, June, August and September, and considerably in excess in October.

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* Until April.

Barometric pressure was considerably above normal in January, March and June, and considerably below normal in February, August and October. The mean pressure for the year was $29^{\text{ins.}}\cdot836$ as against $29^{\text{ins.}}\cdot845$ in 1914 and also $29^{\text{ins.}}\cdot845$ for the past 32 years. The highest pressure was $30^{\text{ins.}}\cdot375$ on January 17 against $30^{\text{ins.}}\cdot367$ in 1914 and $30^{\text{ins.}}\cdot509$ for the past 32 years. The lowest pressure was $29^{\text{ins.}}\cdot354$ on July 28, as against $29^{\text{ins.}}\cdot256$ in 1914, and $28^{\text{ins.}}\cdot735$ for the past 32 years.

It is interesting to note that the lowest pressure for the year (and simultaneously the highest temperature) occurred when the centre of a violent typhoon was about 700 miles to the north-north-east of Hongkong. The wind at the time was light and variable.

The mean temperature for the year was 73°·4 or the same as in 1914, and 1°·7 above normal. It was above normal in each month except in May, when it was 1°·3 below. The highest temperature was 93°·4 on July 28, as against 94°·0 in 1914 and 97°·0 for the past 32 years. The lowest temperature was 41°·7 on January 16, as against 47°·4 in 1915 and 32°·0 for the past 32 years.

According to the records of the Beckley anemograph the wind was again below normal in each month of the year. The mean velocity was 11·4 m.p.h. as against 11·6 m.p.h. in 1914 and 12·8 m.p.h. for the past 32 years. The greatest velocity for one hour was 56 miles at 4 p.m. on November 5, as against 42 miles in 1914 and 108 miles for the past 32 years. The maximum squall velocity, as recorded by the Dines-Baxendell anemograph, was at the rate of 69 miles per hour on November 5, as against 55 m.p.h. in 1914, and 105 m.p.h. for the past 5 years.

In connection with the continued defect in the wind velocity, as recorded by the Beckley anemograph, the following extract from the annual Report of the Director of the Royal Alfred Observatory, Mauritius, for 1914, is of considerable interest:—

> "There is now reason to believe that the low velocities during the years 1901-1911 are almost entirely climatic and due probably to a periodic oscillation in this element."

In support of this statement the Director publishes a table giving the mean monthly velocity of the wind for each lustrum since 1876.

The mean annual values are as follows:—

1876-80	12·39 m.p.h.	1895-1900	10·93 m.p.h.
1881-85	10·90 ,,	1901- 05	10·00 ,,
1886-90	10·43 ,,	1906- 10	9·72 ,,
1891-95	10·82 ,,	1910- 14	10·87 ,,

The mean for the whole period, 1876-1910, is 11·09 m.p.h., so that the total defect of wind from 1901-1910 was 107,807 miles.

At Hongkong there has been a similar defect of wind velocity, which has hitherto been attributed to instrumental rather than climatic causes.

The results may be grouped into the following periods :—

1884-1887,	mean annual velocity	13·9 m.p.h.
1888-1893	,,	13·1 ,,
1894-1897	,,	13·6 ,,
1898-1900	,,	12·8 ,,
1901-1905	,,	12·4 ,,
1906-1911	,,	12·7 ,,
1912-1915	,,	11·6 ,,

From which it will be seen that the wind velocity has decreased more or less steadily from 1885·5 to 1913·5, with partial recoveries at 1895·5 and 1908·5.

If the results be grouped from 1884-1900 and from 1901 to 1915, it will be found that the mean velocity for the former period was 13·33 m.p.h. and for the latter period, 12·29 m.p.h., indicating a defect of 136,731 miles of wind, which is far greater than the secular variations in any other element, and must, at least in part, be attributed to instrumental causes. There will probably be a partial recovery from the very low values of 1913-1915, however.

Rainfall at Four Stations.—In the following table the monthly rainfall at the Observatory is compared with the fall at the Police Station, Taipo ; the Botanical Gardens ; and the Matilda Hospital, Mount Kellet :—

Months.	Observatory (*Kowloon*).	Police Station (*Taipo*).	Botanical Gardens (*Hongkong*).	Matilda Hospital (*Hongkong*).
	inches.	*inches.*	*inches.*	*inches.*
January, ...	0·345	0·50	0·54	0·54
February, ...	0·505	0·90	0·51	0·10
March, ...	2·640	3·24	3·73	2·43
April, ...	1·795	2·84	2·71	2·45
May, ...	12·760	18·67	12·17	10·58
June, ...	11·960	9·92	12·61	11·63
July, ...	15·410	24·80	16·13	11·31
August, ...	10·520	10·45	9·35	7·18
September,...	5·715	2·77	6·28	7·60
October, ...	11·710	6·03	12·97	10·80
November, ...	1·890	3·82	2·51	2·80
December, ...	0·775	1·31	0·98	1·58
Year,...	76·025	85·25	80·49	69·00

Floods.—The heaviest rainfall occurred as follows:—

Period.	Amount. *Inches.*	Interval. *Hours.*
May $12^{d.}$ $7^{h.}$ a.m. to $14^{d.}$ $8^{h.}$ a.m.	5·02	49
June 10 3 ,, ,, 14 9 p.m....	7·70	114
July 2 1 ,, ,, 7 3 a.m.	9·46	122
July 15 10 p.m. ,, 17 5 ,, ...	4·17	31
August 27 4 a.m. ,, 28 11 ,, ...	5·40	31
October 17 6 ,, ,, 19 Noon	9·41	54

Typhoons.—Six typhoons approached within 300 miles of Hongkong during the year, but no destructive winds were experienced. A squall at the rate of 69 m.p.h., however, was recorded during the passage of the typhoon of November 5, at 4.40 p.m. The mean hourly velocity at this time was 56 miles from E by S; the maximum for the year. On June 29 a typhoon entered the coast about 70 miles to the east of Hongkong, having given but little warning of its approach. Fortunately it was of feeble intensity.

The tracks of 14 typhoons and 12 of the more important depressions which occurred in the year 1915 are shown in two plates in the Monthly Meteorological Bulletin for December, 1915.

IV.—WEATHER FORECASTS AND STORM WARNINGS.

Daily Weather Report and Map.—A weather map of the Far East and the Daily Weather Report, containing meteorological observations, usually at 6 a.m. and 2 p.m., from about 40 stations in China, Indo-China, Japan and the Philippines, and a daily weather forecast for Hongkong and district, the Formosa Channel, the south coast of China between Hongkong and Hainan, and the south coast of China between Hongkong and Lamocks, were issued as in former years. Copies of the map were exhibited on notice boards at the Hongkong Ferry Pier, the Blake Pier, and the Harbour Office. One copy was sent daily to the Director of the Meteorological Observatory, Macao. The maps were reproduced from the original by the Roneo Litho duplicator. Forty copies of the Daily Weather Report were distributed to various offices, etc., in the Colony, and a copy was sent daily to the Director of the Meteorological Observatory, Macao. Copies were sent every week to Lieutenant-Commander Pradiyat, Royal Siamese Navy.

The Monthly Meteorological Bulletin, which includes the Daily Weather Report, was distributed to the principal observatories und scientific institutions of the world.

Beginning with 1914 January 1, a charge of $10 a year has been made for supplying firms and private individuals with the Daily Weather Report. This has had the desired effect of reducing the distribution list and so accelerating delivery.

Daily Weather Telegrams.—Daily Weather Telegrams from East Coast Ports, Indo-China, the Philippines, and the Japanese Empire have been received with commendable regularity throughout the year. The service from Wladivostock was interrupted from July 20 to the end of the year.

There was no improvement in the services from Hoihow and Pakhoi, nor from the central China stations until the month of December, when telegrams from Hankow, Ichang, Kuikiang, Changsha and Chung King arrived with fair regularity, from 12 to 36 hours late, however.

Telegraphic communication between the Observatory and Gap Rock, an extremely important station, was interrupted during the typhoon of October 30 and had not been restored by the end of the year.

The new 6-letter code for daily weather telegrams was brought into use on February 15, by the Observatories in Formosa, Indo-China, Macao, the Philippines, and Zikawei; and a simplified form of the code, obviating conversions and reductions, by the observers at Amoy, Labuan, Sharp Peak and Weihaiwei. Formerly the only elements received from Labuan were barometric pressure and temperature, but at the request of the Acting Director of the Observatory, the Government Medical Officer of Labuan has kindly forwarded in addition the wind direction and force, humidity, and weather from the beginning of July. The Japanese Weather Bureau has not yet adopted the new code.

Extra Weather Telegrams.—The following stations send extra weather telegrams at half-rates, during typhoons, on receipt of certain code words from Hongkong:—Amoy, Canton, Macao, Phulien, Sharp Peak, and Taihoku. The Director of the Philippines Weather Bureau also sends extra telegrams at his discretion, from Aparri, or some other station nearer the typhoon centre.

From May to October the 9 p.m. observations at Swatow, in addition to the 6 a.m. and 3 p.m., were forwarded to the Observatory by the Customs authorities, as in previous years.

A wireless telegraphy station at Cape d'Aguilar was opened on July 15, and since that date Meteorological Observations have been received by wireless telegraphy from ships as follows:—

Month.	American.	British.	French.	Japanese.	Dutch.
September,	0	2	0	10	5
October, ...	0	7	0	12	14
November,	0	16	0	12	21
December,	0	2	0	9	16

In return for these observations ships within range of Cape d'Aguilar station receive weather forecasts daily at 1 p.m., and also any storm warnings that may be issued by the Observatory.

The following notice was sent to all vessels calling at Hongkong with wireless telegraphy installations. It has been in abeyance, however, since the beginning of December, for military reasons:—

No. 392. COLONIAL SECRETARY'S DEPARTMENT.

Notice to Shipmasters.

1. Masters of vessels possessing radio-telegraphic installations are earnestly requested to co-operate in the forecasting and storm-warning work of the Royal Observatory, by communicating meteorological observations made on board, to the station at Cape d'Aguilar with all possible speed. The data particularly requested are:—

The ship's name, position, and the time of observation.
The reading of the barometer.
The reading of the attached thermometer (if the barometer is of the mercurial type).
Wind direction and force (Beaufort scale).
State of weather (Beaufort notation).

During the period May 1st to October 31st, observations made at 6 a.m. and 2 p.m. are desired; from November 1st to April 30th the 6 a.m. observations alone. At any time of the year, when there is reason to believe that the ship is in the vicinity of a storm-centre, the prompt communication of meteorological observations at hourly intervals would be invaluable.

2. These communications should be sent as Master Service messages; no charge will be made by the d'Aguilar station, and none should be registered upon the ship. In return for the information supplied, the d'Aguilar station will, at 1 p.m., communicate to all ships within range of its installation, the summary of weather conditions and forecast issued by the Royal Observatory daily. Should subsequent information warrant any modification of the summary or forecast, such modification will be communicated by the Director of the Royal Observatory to Cape d'Aguilar, and, if of sufficient importance, it will be transmitted to the ether for the benefit of all shipping within range.

3. Particulars of the position and direction of progression of typhoons, and any meteorological information likely to be of use to shipping generally, will also be furnished to the Cape d'Aguilar station, and communicated to any vessel upon request.

4. It should be understood that all information supplied by the Royal Observatory is the best that can be given with the information at the disposal of the Director, and that the accuracy of such information will inevitably increase with the number of ships regularly telegraphing observations.

5. In order that a comparison between the ship's barometer and the Observatory standard may be made, it is particularly important that a few readings of the ship's barometer be taken in Hongkong harbour, and forwarded to the Observatory whenever possible. Franked envelopes for the free transmission of this, or any other meteorological communication, may be obtained on application to the Royal Observatory.

A. M. THOMSON,
Colonial Secretary.

27th August, 1915.

The service promises to be a success, and when taken up by all equipped vessels as a routine duty, will be of very considerable utility in connection with daily weather forecasts as well as storm warnings.

The principal difficulties at present are the uncertainty as to what, if any, corrections have been applied to the barometer readings, and the use of aneroid barometers with shifting zeros. Endeavours are being made to remedy the first difficulty, but the second can never be remedied while the use of aneroid barometers is permitted,

Results of Weather Forecasts.—The results of the comparison of the daily weather forecasts with the weather subsequently experienced are given below, with the results of the previous five years:—

Year.	Complete Success.	Partial Success.	Partial Failure.	Total Failure.
	%	%	%	%
1910	58	32	9	1
1911	55	32	11	2
1912	62	34	3	1
1913	66	28	3	3
1914	62	32	5	1
1915	54	37	8	1

Storm Warnings.—Storm warnings according to the "China Coast" code, and the local code, were displayed when necessary. Others according to the Hongkong telegraphic code were sent to the following ports:—Amoy, Swatow, Sharp Peak, Macao, Canton, Pakhoi, Hoihow, Phulien, Manila, Labuan, and Singapore. For the benefit of vessels taking shelter in Kowloon Bay and to the west of Stonecutters Island, the local warnings are repeated at Lyemun by the military authorities and at Lai-Chi-Kok by the Standard Oil Company.

In the following table are given the number of hours the local signals were hoisted in each of the years 1911-15*

Year.	Red Signals.	Black Signals.	Bombs.
	Number of hours.		Number of times fired.
1911	73	377	2
1912	151	164	..
1913	146	189	1
1914	146	178	...
1915	64	12	..

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* The red signals indicate that the centre of the typhoon is believed to be more than 300 miles distant and the black less than 300 miles. Three bombs fired at intervals of 10 seconds indicate that winds of typhoon force are anticipated.

The figures in the above table include the number of hours that night signals, corresponding to the red and black day signals, were hoisted.

V.—METEOROLOGICAL OBSERVATIONS FROM SHIPS, TREATY PORTS, &C.

Logs received.—In addition to meteorological registers kept at about 40 stations in China, meteorological logs were received from 163 ships operating in the Far East. These logs, representing 9,251 days' observations, have been utilised for determining typhoon tracks and for those squares of the proposed Pilot Charts for which information is lacking. The corresponding figures for the year 1914 were 308 and 17,011.

Comparison of Barometers.—During the year more than 1,500 comparisons of ships' barometers have been made by means of observations taken when in harbour, and several direct comparisons of barometers for shipmasters and various persons in the Colony.

One ship's barometer, whose index had remained unchanged when near the centre of a typhoon in the China Sea, was tested at the Observatory and found to be so clogged that even when the pressure was reduced to 28 inches the index showed no movement. After cleaning, the behaviour of the instrument was better than the average.

VI.—MAGNETIC OBSERVATIONS.

Absolute determinations of magnetic horizontal force, dip, and declination were made near the middle of each month with instruments of the Kew pattern. In the determinations of horizontal force two sets of deflection observations were made, one before and one after the vibration observations. Four dip needles were used in rotation, two on one day of each month.

The alterations to the Kew Magnetometer No. 83, which was sent to England in February 1914, were completed early in the year. The instrument was then compared with the Kew Standard by the Kew observer in February and by the Director of the Hongkong Observatory in June and July, when on leave of absence.

The results of the comparisons are given below :—

Date.	Kew – 83.
February, ...	+ 28γ
"	+ 28
June 24^d 11^h	+ 29
" 24 12	+ 32
" 24 15	+ 72
July 1 11	+ 28
" 1 12	+ 31
" 1 15	+ 33

Rejecting the result at 15^h on June 24, which appears to be wrong, we have + 31γ as the correction obtained by Mr. Claxton, and + 28γ by the Kew Observer. The mean of the 7 accepted values is 30γ, which may be considered as the correction to apply to reduce to the Kew Standard in 1915.

The mean values of the Magnetic elements for the years 1914 and 1915 were as follows :

	1914.	*1915.*
Declination (west), ...	0° 8′ 31″	0° 11′ 40″
Dip (north), ...	30 53 28	30 52 10
Horizontal Force (C.G.S. unit),...	0·37192	0·37167
Vertical Force (C.G.S. unit), ...	0·22351	0·22217
Total Force (C.G.S. unit), ...	0·43340	0·43293

In the month of February Mr. F. Brown, of the Carnegie Institute, Magnetic Section, in co-operation with Messrs. Claxton, Jeffries, and Evans, made a series of comparisons between the magnetic instruments of this Observatory and a set of C. I. instruments, before setting out on a magnetic survey of North China. The results of the comparisons have not yet been received.

VII.—TIME SERVICE.

Time Ball.—The Time Ball on Blackhead's Hill is dropped daily at 13^h Hongkong Standard Time (5^h a.m. of Greenwich Time). The ball is also dropped at any other hour in case of necessity. One application for a supplementary time signal was made in the year 1915 ; on February 8. The ball was dropped successfully 365 times. There were no failures.

The ball was not raised on November 5 owing to strong wind. It fell with an error of $0^{s}\cdot 3$ or less on 300 occasions, with an error of $0^{s}\cdot 4$ or $0^{s}\cdot 5$ on 37 occasions, and $0^{s}\cdot 6$ or $0^{s}\cdot 7$ on 11 occasions. Errors of $0^{s}\cdot 8$ occurred four times, of $0^{s}\cdot 9$ once, of $1^{s}\cdot 0$ four times, and $1^{s}\cdot 1$, $1^{s}\cdot 2$, $1^{s}\cdot 3$, $1^{s}\cdot 8$, and $2^{s}\cdot 3$ once each. The probable error varied from $0^{s}\cdot 10$ in October, to $0^{s}\cdot 43$ in February.

Portions of the framework and cover of the ball were repaired in the month of May.

Transit Instrument. Observations for time were made daily with the 3-inch transit instrument and the Hipp tape chronograph by the Chinese computers, weather permitting.

The number of observations in the years 1914 and 1915 were as follows:—

	1914.	*1915.*
Transits, ...	1,803	1,817
Level determinations, ...	893	854
Azimuth determinations, ...	17	32
Collimation determinations, ...	43	30

Transits of the sun were only observed when star transits were not available from the previous night.

The azimuth and collimation determinations were made by the Chief or First Assistant. The azimuth determinations depend usually on observations of the north and south marks.

The ruled glass scale, which was substituted for the spider threads in the transit instrument on 1914 August 18, was replaced by a new glass with deeper lines in April 29. The lines on the original glass were too fine, and invisible in certain lights.

Clocks.—On March 29, the Standard sidereal clock, Dent No. 39,741, was cleaned and fitted with an invar pendulum, and hardened lead bob. The pendulum was regulated to a losing rate of $0^{s}\cdot 2$ a day, but the rate increased to $1^{s}\cdot 2$. It was again regulated on June 1 and 3, after which its rate varied from $+0^{s}\cdot 30$ on June 9 to $+0^{s}\cdot 08$ on June 30. It then remained remarkably steady till July 26. From this date its rate commenced to decrease, reaching $-1^{s}\cdot 04$ on October 12, when it was again regulated. After a very steady period the rate increased from $+0^{s}\cdot 02$ on November 11 to $+0^{s}\cdot 36$ on November 19. It has fluctuated between $+0^{s}\cdot 33$ and $+0^{s}\cdot 08$ since.

At present there is not sufficient data available for determining the temperature, pressure, and humidity co-efficients. When examined at the National Physical Laboratory, London, the mean co-efficient of linear dilatation of the pendulum rod was found to be ·00000017 between the temperatures 32° and 86° Fahrenheit.

It is suspected that the electric sidereal clock on the same pillar, which was re-started on November 17, has affected the rate of the sidereal standard. If an appreciable effect is found new pillars will have to be provided for the electric sidereal clock, and also for the Brock mean time clock which is on the same pillar as the Dent mean time clock.

In the following table is given the excess of the observed over the calculated rate after cloudy periods in the year 1915:

Excess of observed over calculated errors of Dent No. 39741, after cloudy periods in the year 1915.

Date 1915.		Interval without observations.	Excess of observed over calculated error.	Date 1915.		Interval without observations.	Excess of observed over calculated error.
		d.	*s.*			*d.*	*s.*
January	5	2	+0·12	May	19	2	0·00
„	16	3	−0·40	„	23	2	−0·12
February	3	6	+0·62	„	27	2	−0·25
„	10	6	+0·99	June	6	2	−0·04
„	15	-	*+0·56	„	14	5	+0·53
March	3	2	−0·07	July	4	2	+0·66
„	10	2	+0·56	August	3	2	+0·48
„	18	6	−0·44	September	19	2	−0·03
April	6	8	−2·37	November	2	3	+0·05
„	20	3	−0·40	„	6	4	+0·11
„	28	6	+0·11	„	14	2	−0·03
May	3	2	−0·27	„	19	2	−0·25
„	10	3	−0·40	„	22	2	−0·11
„	14	3	+0·52	December	12	2	+0·27

* After mounting new pendulum.

The Dent mean time clock, No. 39710, which was sent to Messrs. E. Dent & Co., London, in June, 1914 to be fitted with an invar pendulum, with hardened lead bob, and electric contacts for emitting 2-second signals was received back on February 16, and set up the following day. The clock has not yet settled down to a steady rate, and no pressure or humidity co-efficients can be determined from the rates obtained up to the present. It would appear, however, that an increase of 1° F. of temperature increases the daily gaining rate by 0·039. When examined at the National Physical Laboratory, London, the mean co-efficient of linear dilatation of the pendulum rod was found to be *nil* between the temperatures 32° and 86° Fahrenheit.

The Brock clock has been used for dropping the time ball throughout the year and for driving dials in various parts of the building. It has worked without failure, and the electric contacts have required no adjustment. The rate has been erratic at times, however, in spite of the invar pendulum fitted in 1914. The clock is corrected daily by the electric regulating apparatus, and its daily rate is usually kept within 0·5 by the addition or removal of weights from the pendulum.

The rate of chronometer Kullberg No. 8546 has improved somewhat, but has not settled down to the excellent rate reported in 1913.

The only failures with the electric impulse dials have been those due to exhausted primary batteries. The motive power is now derived from the accumulator and no further trouble is anticipated.

The pallet of the electric standard clock was jewelled, the bearings of the gravity roller improved, and the effective weight of the gravity arm reduced, free of charge, by Messrs. Gent & Co., and fresh experiments are being made to determine the best working values of impulse, arc, and friction, under the new conditions.

Accumulators. The installation of an accumulator battery of ten three-plate Tudor cells of 27 ampère-hour capacity and 9 ampères maximum discharge, which was commenced by the Public Works Department in the month of November, 1913, was delayed on account of the illness of the Government Electrician, and ultimately placed in the hands of the China and Japan Telephone Company. The cells were remounted and a Nodon valve, consisting of four iron jars with aluminium electrodes, substituted for the valve originally supplied, which was found to be unsatisfactory. The new valve also gave considerable trouble owing to the inferior quality of the ammonium phosphate, and possibly to other causes.

The valve was cleaned on November 25, and a new solution of ammonium phosphate, recently received from England, substituted for the old solution in which was found a very heavy deposit. The valve has since worked well, but considerable crystalization takes place, and a fan is necessary to prevent undue heating.

A duplicate valve, consisting of four glass jars with lead electrodes, in place of iron jars (which served also as electrodes), was constructed by Messrs. Jeffries and Evans in the month of July. With the new ammonium phosphate this valve has worked well, so far. Either valve may be brought into use by means of a four pole two-way switch fitted on a subsidiary charging board which is used for charging an electric hand lamp through a shunt across the main D.C. charging circuit. The necessary reduction of current is obtained by placing three electric light bulbs in the shunt circuit.

Time Signals by Wireless Telegraphy.—After consultation with the Astronomer Royal the following apparatus was ordered for receiving time signals by wireless telegraphy :—

1 tuner (Admiralty pattern)

1 crystal detector and rheostat (Sullivan pattern)

2 highest grade telephone receivers (Sullivan pattern) of 2,000 ohms resistance.

The choice of a relay, or amplifier, has been left open until the results of experiments with two new types, recently placed on the market, are made known.

It is anticipated that masts 100 feet high will be required for the aerial in order to obtain time signals from Shanghai ; but masts 75 feet high will probably suffice to receive time signals from the Phulien and Manila Observatories.

Apparatus for distributing time signals has recently been ordered from Messrs. L. Leroy & Cie, Paris.

VIII.—MISCELLANEOUS.

Staff.—Miss A. Doberck, Assistant Meteorologist, resigned on February 22, on account of ill health. The post has been abolished and a 3rd Grade Clerical Assistant substituted. To this office Badan Singh was appointed on March 15, on one year's probation. During the absence on leave of the Director, from February 25 to November 16, Mr. C. W. Jeffries, the Chief Assistant, acted as Director and Mr. B. D. Evans, the First Assistant, acted as Chief Assistant.

The European Staff acted as cable censors as follows :—

Director, 4 hours daily from January 1 to February 22.

Chief Assistant, 4 hours daily from January 1 to May 31,
and October 28 to December 31.

,, 2 hours daily from June 1 to July 31.

First Assistant, 4 hours daily from January 1 to May 31,
and August 1 to December 31.

,, 2 hours daily from June 1 to July 31.

Expenditure.—The annual expenditure on the Observatory for the past ten years is as follows:—

Year.	Total Expenditure.	Increase.	Decrease.
	$ c.	$ c.	$ c.
1906	19,995.17	......	1,225.23
1907	20,110.53	115.36	......
1908	21,110.61	1,000.08	......
1909	22,388.63	1,278.02	......
1910	21,787.55	......	601.08
1911	23,353.02	1,565.47	......
1912	22,595.08	......	757.94
1913	24,255.49	1,660.41	......
1914	25,398.31	1,142.82	......
1915	23,233.12	......	2,165.19

Acknowledgments.—Acknowledgments are here made to the Directors of Weather Services in the Far East, and the Chinese Maritime Customs authorities for daily observations and extra observations during typhoon weather; to the Telegraph Companies, for transmitting the observations free of charge; to the commanders of vessels who have furnished meteorological observations, and to the Observatory staff for the manner in which they have carried out their respective duties, particularly to Mr. C. W. Jeffries for the efficient manner in which he directed the work of the Observatory during my absence on leave. I have again to thank Captain W. L. Carter, R.E., for assistance in the maintenance of the electrical apparatus of the Time Service.

T. F. Claxton,
Director.

1916, February 7.